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Finnish Education Professionals' Thoughts on Adaptive Learning Technologies

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Abstract

With the rapidly increased use of digital technologies in education due to the COVID-19 pandemic, it is important to discuss these technologies' impact on the teaching profession. Using thematic analysis and epistemic network analysis (ENA), we analyzed 114 social media posts by Finnish education professionals commenting on an opinion piece about technology partly taking responsibilities usually attributed to a teacher. Out of the analyzed posts, 32 were supportive, 30 ambivalent, and 52 critical towards the presented scenario. The epistemic network analysis graphs showed some differences between posts with a different attitude. Supportive posts, on average emphasized technological capabilities and their connections with teacher workload and self-directed/self-regulated learning. In comparison, the critical posts on average emphasized human presence and its connections with pupil diversity and technological capability. Our findings both reveal the relevant themes in the discussion about technologies' impact on the teaching profession and underline the differences in supportive and critical argumentation.

Keywords

adaptive learning technologies, self-regulated learning, teaching profession

1. Introduction

While digitalization and automation have disrupted many industries in the last few decades, education has largely been an exception to this trend. As Selwyn puts it, "most people intuitively feel that education is an essentially human undertaking" and "the belief persists that learning is something best guided by expert human teachers in socially rich setting" [1, p. 1].

However, now that the COVID-19 pandemic has interrupted classroom learning for at least 9 out of 10 students worldwide [2], schools and teachers around the world have been forced to find ways to maintain continuity of learning without physical proximity. While the exceptional methods used during the school closures have mostly been ad hoc and in many ways inferior to classroom learning, this large-scale experimentation with digital technologies will likely affect education also in the post-covid world. In particular, it is interesting whether the new technologies have an impact on how teacher's role and the teaching profession are seen.

In the present study, we examine Finnish education professionals' thoughts on digital technologies in education and their impact on the teaching profession. First, we present relevant background related to artificial intelligence in education and technology-enhanced self-regulation of learning, followed by our research questions.

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1.1. Artificial Intelligence and the Teaching Profession

Novel technologies such as machine learning and artificial intelligence are changing labour markets and disrupting industries. Computerization of work is moving fast from routine tasks involving explicit rule-based activities to non-routine cognitive tasks [3]. There are two prominent scenarios when applying artificial intelligence at work, namely automation and augmentation. Whereas automation implies that machines take over a human task, augmentation means that humans collaborate closely with machines to perform a task [4]. From employee perspective, a study shows that perception of technology replacing one's job is generally low, although participants under 30 were more worried than older age groups [5]. In another study among a range of industries employees perceived "human touch" and "soft skills" as irreplaceable by novel technology [6].

Regarding the teaching profession, teachers are considered to have a low risk of computerization [3], and thus, the augmentation scenario is more likely than the automation scenario. The concept *teaching augmentation* has been used to describe tools extending teachers' pedagogical abilities [7]. These technologies potentially shaping the future of teacher's profession are evolving rapidly and include e.g. learning analytics applications [8], intelligent tutoring systems [9], adaptive learning technologies [10] and educational chatbots [11, 12].

It is essential to acknowledge, that no technological innovation will inevitably change teaching profession. As Selwyn [1] points out, integration of any technology to society should be approached as a choice: "it is crucial that we consider the possibility of alternative technological pathways and different digital futures for education". He presents two scenarios how AI may change the teaching profession. In the first scenario AI frees up teachers to engage in meaningful acts of leading, arranging, explaining, and inspiring while technology takes care of routines and duties. In the second scenario, technology becomes an institutional tool of performance management, and teachers end up losing their autonomy while fulfilling the expectations of the technology, e.g., encouraging students to write in ways favored by automatic grading systems [1].

1.2. Technology-enhanced Self-regulation of Learning

Self-regulated learning refers to how learners systematically activate and sustain their cognitions, motivations, behaviors, and affects toward the attainment of their learning goals [13]. In a classroom setting, the teacher can support learners' self-regulation and then gradually decrease the amount of support, promoting the learning of self-regulation skills.

With the development of adaptive learning technologies (ALTs, see e.g., [10]), this role of scaffolding support may partly be transferred to technological systems. Researchers have envisioned "a hybrid human-system regulation with fluctuating boundaries between student and system control" where "embedded learning analytics techniques can support a new generation of SRL support that adjusts external regulation based on insights gained from data" [10, p. 473] and presented a framework for human–AI hybrid adaptivity [14], describing how humans and educational AI systems can augment each other in many ways. Moreover, it has been pointed out that the development of human-AI systems should engage practitioners (in this case, teachers) throughout the lifecycle of system development and that these systems should

be studied in real-world contexts [15]. While these technologies are still at their preliminary stages, their sophistication will grow over time.

In summary, it is highly likely that new technologies will change the teaching profession in one way or another. Therefore discussing these topics within the community of education professionals is extremely important.

1.3. Aims of the Current Study

With the massive increase in the use of digital tools in teaching and learning during the pandemic, it is important to investigate implications to educational arrangements in general and to teaching profession in particular. Based on literature, we know that machines can successfully handle many routine teacher tasks such as grading. However, supporting learners' self-regulation has been an exclusively human endeavour and central to the teaching profession. As digital systems get more sophisticated, it is important to discuss the possibilities and limitations of a machine to guide, encourage and support students with their self-regulation broadly in the educational community.

In the present study, we analyze social media posts commenting on an opinion piece published in the largest daily newspaper in Finland. The author of the opinion piece describes how learning of new content is increasingly guided by adaptive learning technologies instead of a human teacher and how this kind of shift would free teachers' time to focus on tasks where humans are best. Our research questions are following:

- **RQ1:** What kind of argumentation Finnish education professionals use in social media discussions to support or criticize a scenario of adaptive learning technologies taking responsibilities traditionally attributed to teachers?
- **RQ2:** How do Finnish education professionals see the role of a teacher in contrast to the role of technology in supporting pupils' self-directed and self-regulated learning?

2. Methodology

2.1. Context

In Finland, all schools shifted to remote learning because of the covid-19 pandemic for eight weeks during spring 2020. Afterwards, schools have shifted between contact teaching and remote learning depending on the development of the epidemic in each region.

During the pandemic, there have been active discussions in Finnish media about learning with digital technologies. One contribution to this discussion is an opinion piece [16] written by a Helsinki-based elementary school teacher and published on April 19th 2021 by Helsingin Sanomat, the largest daily newspaper in Finland. The author suggested introducing weekly remote learning, where elementary school pupils would study remotely one day a week leveraging digital learning platforms. He describes how this kind of shift would free teachers' time to focus on things where humans are best, such as contextual interaction.

The piece generated lots of comments in social media, especially in two Facebook groups: a general forum for discussion among Finnish education professionals (ca. 17 500 members) and

a group specializing on the teaching profession (ca. 13 000 members). Comments were posted during April 2021.

2.2. Material

Social media posts were gathered from the Finnish education professionals group (N=48), teaching profession group (N=81) on Facebook, Twitter (N=12), and newspaper comment board (N=10). Posts that did not include any argumentation (e.g. posts with only one word or emoticon) were removed from the dataset, ending up with 114 posts. In addition to the post content, the amount of social media reactions (i.e. likes) were collected for each post. The opinion piece as well as all the comments were originally written in Finnish and the excerpts presented here have been translated into English by the authors.

2.3. Analyses

2.3.1. Attitude towards the scenario.

The posts were rated by both authors as *supportive*, *critical* or *ambivalent*, based on the attitude towards the presented scenario. The inter-rater reliability was moderate (Cohen's kappa 0.68)[17].

2.3.2. Thematic analysis.

Inductive thematic analysis was used to analyze the themes included in the social media posts. Both authors took part in the process. First, the first author coded all the posts and created the initial coding scheme. Typically each post was assigned two to five codes. Next, the second author used the coding scheme with 20 first posts. Then, inter-rater differences were discussed, and the coding scheme was readjusted (e.g. two of the initial codes were removed). Finally, both authors used the agreed flat coding scheme with all the posts. The codes with their descriptions and inter-rater reliability are presented in Table 1. Inter-rater reliability ranged from moderate (Cohen's kappa 0.61) to strong (Cohen's kappa 0.84)[17].

2.3.3. Epistemic Network Analysis.

In this study, we applied Epistemic Network Analysis [18, 19, 20] to our data using the ENA 1.7.0 Web Tool [21]. Our ENA model included the codes presented in Table 1. We defined conversations as all posts associated with a single social media forum. The ENA model normalized the networks for all units of analysis before they were subjected to a dimensional reduction, which accounts for the fact that different units of analysis may have different amounts of coded lines in the data. For the dimensional reduction, we used a singular value decomposition, which produces orthogonal dimensions that maximize the variance explained by each dimension (see [18] for details).

In this study, ENA was used to compare mean networks of posts with *supportive*, *critical* or *ambivalent* attitude towards the presented scenario. Networks were visualized using network graphs where nodes correspond to the codes, and edges reflect the relative frequency of co-occurrence between two codes. The positions of the network graph nodes are determined by

an optimization routine that minimizes the difference between the plotted points and their corresponding network centroids. Because of this co-registration of network graphs and projected space, the positions of the network graph nodes and the connections they define can be used to interpret the dimensions of the projected space and explain the positions of plotted points in the space. Our model had co-registration correlations of 0.93 (Pearson) and 0.93 (Spearman) for the first dimension and co-registration correlations of 0.91 (Pearson) and 0.91 (Spearman) for the second. These measures indicate that there is a strong goodness of fit between the visualization and the original model.

Table 1
Codes with their descriptions and inter-rater reliability

Code	Description	Cohen's kappa
ARR	*Educational arrangements:* Considerations how teaching and/or learning are arranged	0.65
PRE	*Human presence and interaction:* Mentioning human presence, importance of interaction or interaction skills	0.71
TEC	*Technological capability:* Properties and possibilities of technology are discussed	0.65
WOR	*Teacher workload and efficiency:* Expressions related to teacher workload and/or efficiency	0.84
DIV	*Pupil diversity and equality:* Differences between pupils or expressions related to equality between pupils	0.61
SEL	*Self-directed/self-regulated learning:* Mentioning either pupils' self-directed/self-regulated learning skills or the role of teacher/system in supporting pupils' self-regulation	0.73

3. Findings

The number of posts including each code as well as sum of likes of those posts are presented in Table 2. Out of 114 posts analyzed, 32 (28 %) were supportive towards the presented scenario, whereas 30 (26 %) were ambivalent and 52 (46 %) critical. While this presents the attitudes of professionals taking part in the discussion, the sum of social media likes shows attitudes of the larger community. Out of 1251 likes, 103 (8 %) were connected with posts showing supportive attitude, whereas 192 (15 %) were connected with posts showing ambivalent and 956 (76 %) with posts showing critical attitude.

3.1. Connections Between Codes

The epistemic network analysis graphs are presented in Figure 1. The most central code was *Educational arrangements (ARR)*, having strong connections with all other codes. When comparing the networks of supportive and critical posts, it is clear that different themes are

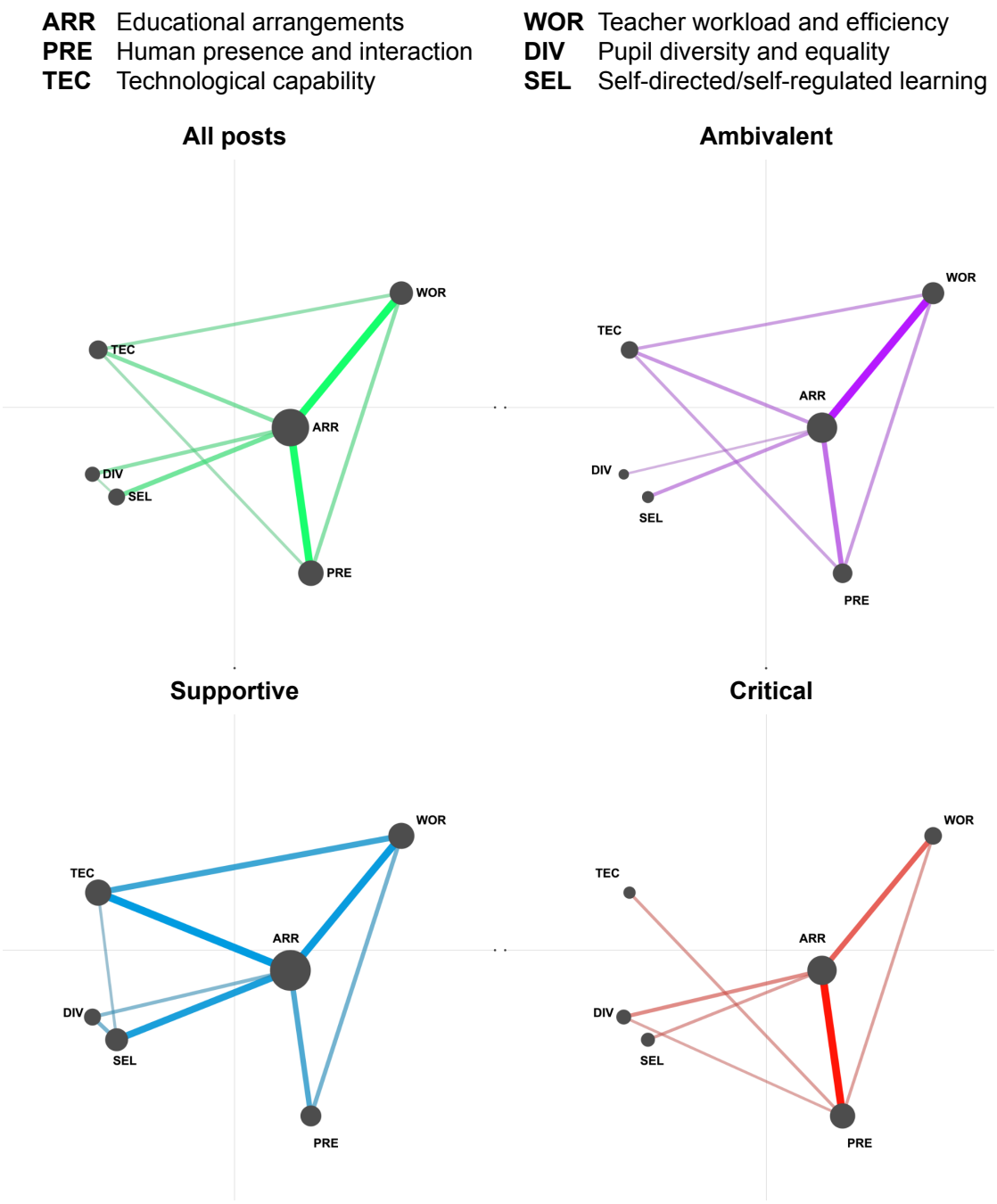

Figure 1: Mean networks of posts with different attitudes towards the presented scenario.

highlighted. In the supportive network, the focus is on connections with *Technological capability (TEC)* and in the critical network on connections with *Human presence and interaction (PRE)*

Moreover, it is interesting to compare which connections are missing in each graph. In the

Table 2
Number of posts and sum of likes by code

Code	Supportive		Ambivalent		Critical		Total	
	Posts	Likes	Posts	Likes	Posts	Likes	Posts	Likes
ARR	22	84	18	157	37	699	77	940
PRE	13	44	7	20	24	563	44	627
TEC	21	57	7	9	15	402	43	468
WOR	12	47	13	42	17	309	42	398
DIV	8	40	4	28	16	377	28	445
SEL	10	36	3	123	14	390	27	549
Total	32	103	30	192	52	956	114	1251

supportive network, connection between *Pupil diversity and equality (DIV)* and *Human presence and interaction (PRE)* is missing, as well as connection between *Technological capability (TEC)* and *Human presence and interaction (PRE)*. Respectively in the critical network, the connection between *Technological capability (TEC)* and *Teacher workload and efficiency (WOR)* is missing, as well as the connection between *Technological capability (TEC)* and *Self-directed/self-regulated learning (SEL)*.

In the following, we take a deeper look into the roles of technology and teacher in guiding and supporting pupils.

3.2. The Roles of the Teacher and Technology in Supporting Pupils

Many comments emphasized pupils limited self-directed and self-regulated learning skills. This was often coupled with the notion of challenges in supporting self-regulation remotely:

> *"Uppermost the delusion that you could just 'leave' the children to study the vocabulary etc. Not at all. Online the teacher presence is highlighted more intensively so that high-quality learning and continuous assessment can happen. It requires a lot: both from teachers and pupils. The most self-directed learners can surely do something as described, but I would not in any case - and fortunately it's not legally possible - categorically increase remote learning in basic education."*

> *"[–] The pupils aren't self-directed except for a few cases. Most of them need interaction and discussion about other things among teaching. That works best live, worse remotely."*

Some of the critical comments directly addressed the shortcomings of technology in guiding and supporting pupils:

> *"This digital-environment-self-directed-learning mantra has been tooted as forthcoming for thirty years now. Nevertheless, give any 'self-directing' learning material*

or digital platform to a group of 24 pupils and follow the situation for 45 minutes. I'll eat my hat if even half of the group is doing what they're supposed to with the program, or if they're even in the program. In small bits, yeah, but replacing teachers, doubt it."

Other comments did not mention the technology but emphasized that guiding and supporting should be carried out by the teacher:

"Oh my god! Teacher's role is to follow how learning proceeds and help when necessary. For example, there are a lot of tools and collaborative learning plans for multiplication tables."

On the other hand, there were many comments which described how technology would be able to support pupils :

"The technology should distribute exercises, grade them, correct errors, praise success, and guide otherwise too. The teacher would get some kind of overview."

"Using digital materials does not necessarily lead to an increase in distance education, but creates also possibilities for individual work by providing direct feedback and differentiation possibilities. At school, or at home."

As described in the Introduction, a skilled teacher gradually decreases the amount of support for learners to learn to regulate themselves. It is an interesting question, whether this kind of fine-grained adaptive regulation support is expected from a machine. One comment included the idea about developing students self-directed and self-regulated learning skills, but it was left a bit unclear whether this development is seen as a side effect of individual studying with technology or as a consequence of scaffolding by either teacher or technology:

"I think that while provocatively formulated, the idea is rather good. Many digital tools fit really well to differentiation and e.g., vocabulary drilling. Pupils could and should be guided to plan, test, and differentiate their learning themselves and, for example, proceed to more advanced exercises or broader vocabulary when the basics work out. [–]"

In another comment, it was suggested that self-regulatory skills could be practised with technology, but there should be a human "backup":

"[–] it's worthwhile to let those with [self-regulatory] problems to have a chance to practise at school. In short snippets and so that someone is there to return drifters back to the track."

There were no comments about technology being capable of directly helping with challenges related to pupil diversity and equality. One comment even pointed out the contrary:

> *"Technology can help a lot in teaching, but will never be a substitute for teacher's help to those with challenges in studying - and it is an increasing crowd!"*

However, some comments noted that technology could indirectly help by freeing up teachers' time:

> *"This can also be seen in a way that if those competent in the independent study are in remote learning, those who are unable may get tailored contact teaching."*

> *"Let's teach just those who need teaching. Others might find learning even easier alone on their own."*

In summary, in the posts that were supportive towards the vision presented in the opinion piece, technology was seen as capable of guiding and supporting students with their self-regulation. On the other hand, the critical posts mostly, rather than criticizing the technology, emphasized the role of the teacher. It seems that the possibilities of technology in guiding and supporting students are recognized to some extent, but technological scaffolding alone is not considered sufficient. Therefore, the role of teacher is seen as necessary even with adaptive learning technologies available.

4. Discussion

In line with previous work among different industries [5], teachers were not concerned of being replaced be novel technologies. When compared to Selwyn's [1] two scenarios of how AI may change the teaching profession, some posts as well as the opinion piece that started the discussion resemble Selwyn's first scenario on AI freeing up teachers time for more meaningful activities. However, in the critical posts, the threat of technology becoming a tool for performance management (as in Selwyn's second scenario) was not visible. The themes of technology and teacher efficiency were not connected in the critical network. Instead, the critical posts emphasized the role of teacher and human presence in facing student diversity and varying levels of self-directedness and self-regulation. Only 29 % of the critical posts even mentioned technological capability. This emphasis on human presence or "human touch" is in line with previous work on employees' perceptions among different industries [6].

In the supportive posts, on the other hand, 66 % mentioned technological capability. Even these posts described the technological possibilities on a rather conservative level, at least if compared to visions of hybrid human-system regulation [10]. For example, the possibilities of learning analytics were mentioned only once.

Moreover, while ethical and legal issues related to collecting and using student data in various applications are active topics in the learning analytics community, these themes were largely absent in this discussion among education professionals.

4.1. Limitations

The present study has some limitations. First, the sample size is small with only 114 social media posts. This is due to the fact that posts considering such a specific topic are scarce - we

were lucky to find this kind of discussion occurring spontaneously. In future work, alternative data gathering methods such as surveys and interviews should be considered.

Second, a clear limitation in this kind of research setting is the question of representativeness. We cannot objectively tell, how well the views presented in the analyzed posts represent the views of Finnish education professionals in general. However, the Facebook groups in question are rather large when taking into account the population of Finland, so at least a substantial share of Finnish education professionals had a chance to take part in this discussion.

5. Conclusions

We analyzed 114 social media posts commenting on an opinion piece about technology partly taking responsibilities usually attributed to a teacher. Our findings indicate that Finnish education professionals mostly do not see adaptive learning technologies disrupting the teaching profession.

There were some differences between supportive and critical posts. Supportive posts connected technological capabilities and self-directed or self-regulated learning, emphasizing that technology can also guide and support students. Critical posts connected human presence, educational arrangements, and student diversity and equality, emphasizing the importance of teacher's presence in addressing pupils' varying needs.

Our findings reveal themes relevant when discussing the development of adaptive learning technologies and their potential impact on teaching profession. Moreover, the findings increase the understanding of how supportive and critical argumentation on technology differ from each other.

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